THE UNIVERSITY OF NEWCASTLE AUSTRALIA

The University of Newcastle

Infrastructure and Facilities Services

Project Briefing Document

Generators and Emergency Power Suppplies.

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THE UNIVERSITY OF NEWCASTLE AUSTRALIA

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Contents

1. Scope

This Specification covers the general requirements applicable to the design, manufacture, performance and delivery of Site Generators, Compounds and Generator Control Systems.

It is not the intention to specify details of design and construction except where necessary to establish performance requirements, nor is it the intention to set forth those performance requirements which are adequately specified by the applicable Standards.

This specification shall be read in conjunction with Standard Specification UON-ESS-101 Electrical Design Criteria.

2. Standards, Specifications and Statutory Obligations

All aspects of design, manufacture, testing, supply, plant, equipment, accessories, materials, construction, erection, installation, operation and performance shall comply with this Specification and the current issue of the relevant Australian Standards, the relevant International Standards, the UON Standard Specifications and Preferred Equipment List, as well as all Statutory Acts, Codes, Regulations and Requirements of the relevant Authorities having jurisdiction over them unless specified otherwise within this Specification.

These shall include but not be limited to:

Australian/International Standards

AS 2790	Electricity generating sets - Transportable (Up to 25 kW)
AS 3000	Wiring Rules
AS 3112:2011	Approval and test specification - Plugs and socket-
AN 61000	Electromagnetic Compatibility
AS 1359	General Requirements for Rotating Electrical Machines
AS 2006	Diesel Generators/internal combustion engines
AS 2184	Low voltage switchgear and control gear
AS 2373	Electric Cables
AS 2374	Power Transformers
AS 3010	Electrical Installations
AS1939	Enclosure IP ratings
AS 4509	Stand-alone power systems, Parts 1,2,3
AS 3008	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV
AS 60038	Standard Voltages
AS 3600	Concrete Structures.
AS 60204.1	Safety of machinery—Electrical equipment of machines
AS 3100:2009	Approval and test specification - General requirements for electrical equipment.

University of Newcastle Standards

UON-ESS-101 General Electrical Specification.
UON Preferred Equipment List.

Authorities and Statutory Acts, Codes, Regulations and Requirements

BCA
Worksafe NSW
NSW Electrical Licencing & Regulation
NSW Service and Installation rules.

Where the stipulations of this Specification, the data sheets and the drawings do not comply with the minimum requirements of the Australian Standards or Statutory Regulations, the latter shall prevail.

Where the stipulations of this Specification, the data sheets and the drawings are more exacting than the minimum requirements of the Australian Standards and Statutory Regulations, the former shall prevail in the following order:

a) Data sheets and detail drawings
b) Specification and standard drawings.

3. Backup Power Strategy.

The UON (University of Newcastle) has five different strategies for the continuity of electrical supply.

Full backup with seamless changeover – This involves the installation of a permanently connected generator, ATS (Auto Changeover Switch) and UPS (Uninterruptable Power Supply). This system will provide the end user with a continuous, uninterrupted power supply even in the event of a power outage. This is achieved by using a UPS to provide power for the time after the mains power supply is lost and before the generator has run up and is ready to accept the full load. This type of system is required for installations such as Data and Communications centres.

Full Backup Power – This installation would require a permanently connected generator, ATS and associated wiring. This type of installation will provide the user with full backup power in the event of a power outage, however there will be a loss of power between the mains power going down and the generator being ready to take the load. The change between mains power and generator power is achieved using an Auto Changeover Switch that need no intervention. This delay for the generator to start and the ATS to change over will be around 10-30 seconds. This type of installation would be used in an office or common area type installation, any individual items that cannot cope with the short loss of power should have their own local UPS.

Generator Socket Ready installations – These installations have a permanently connected socket connected to the buildings electrical system to allow a generator to be plugged in without modifications to the existing wiring. Once the generator is in place, a manual changeover switch is used to switch between mains supply and generator supply. This installation required a designated position for the generator, a manual changeover switch, and socket and associated wiring. This type of installation would experience a prolonged outage if mains power is lost, 4 hours plus, due to the time required to organise the generator and complete the installation.

Generator Ready Installation – This type of installation would have a designated point of attachment where the generator would be hard wired into the existing installation. It would need to include any equipment that would be required to complete the wiring modifications available at the point of attachment. A full set of guidelines would also be required adjacent to the point of attachment. This type of installation would be used on areas that are not critical but would need power in the event of a prolonged (3 days plus) installation. There would be around 24 hours delay for backup power.

No Backup – This is for areas that are non-critical and in the rare event that there was an extended outage (Multiple weeks), a backup power strategy could be developed depending on the circumstances.

4. Electrical Design

The Generator shall be a 3 phase, 415v 50Hz system. Any installation that includes a permanently connected generator shall ideally be capable of supplying power to the entire load to which it is connected without the use of load shedding or a separated essential services Distribution section. On smaller loads, 250kVA or less, the cost of separating the services into essential and non-essential will usually outweigh the cost of a larger generator and associated equipment. Larger generators should be considered in a case by case basis.

Full Backup Power with seamless changeover shall use an open transition type generator. This type of installation shall utilise an ATS that is capable sensing a loss of power supply and sending a remote start signal to the generator. The UPS shall include a bypass switch to allow the UPS to be maintained or replaced without interrupting the power supply. This type of installation shall also use an “Isolation Chassis” for any power distribution to allow modifications or additions to be undertaken on the electrical system without isolating the supply.

Full Backup Power without seamless changeover shall use a closed transition type generator. This type of installation will require an ATS that is capable sensing a loss of power supply and sending a remote start signal to the generator. If the installation requires load shedding to ensure that the generator is capable of suppling reliable power to the installation, the criticality and size of the individual loads shall be used to produce a switching program that will allow the shedding of non-critical loads and prevent the generator from being overloaded. The load shedding instructions and/or switching program shall permanently displayed at the generator and adjacent to the relevant switchboard. The list of items that are to be shed in a power outage is to be approved by the UON.

All generator installation must include surge protection. If the generator is being retrofit to an installation that already has surge protection, the existing surge protection can be used. If this is a completely new installation or if there is no surge protection on an existing installation, surge protection shall be provided as per UON specifications. A charger circuit shall also be installed to charge the generator batteries, the circuit should be fed from a location that will receive backup power when the generator is running.

Any generator installation that is connected to an existing electrical installation for the purpose of backup power shall use the earthing system incorporated on the existing installation. As per Australian Standards, no additional earth stake should be installed locally at the generator. The generator earth shall be connected to the main earth bar, any MEN link shall be removed from the generator and the MEN link in the fixed installation shall be used.

The size of the generator shall be determined through the use of BMS energy usage data, the use of a data logger and through discussions with the area occupants. BMS data typically will only show limited snapshots of power usage, this is useful but a data log capturing current or kVA will be required to catch the peaks and troughs in usage. The energy profile should also be discussed with the area occupant to capture intermittent or sporadic load events. The Generator set should be rated at 20% above expected load. Sizing calculations and logic shall be presented to The UON representative prior to the purchase or rental of any generator for approval.

The generator shall include a mounted Circuit Breaker, the final setting on this breaker shall take into consideration connected system to for the purpose of discrimination and cascading. A copy of all circuit breaker setting and all other generator settings or parameters shall be supplied to UON for approval prior to completion of the works and as handover documentation once the work is complete.

As a minimum, the generator installation shall have a locally switched light fitting installed above the control panel, the circuit should be fed from a location that will receive backup power when the generator is running.

The electrical design should take into account any local Solar PV installation and the effect the generator installation may have on the Solar PV anti-islanding function.

The Generator Set Alternator shall be as Per UON preferred equipment list or approved in writing by the UON representative.

5. Alarming and Monitoring

Any permanently installed generator shall have status inputs into the UON site EMS and Cardex systems. Ready, Run and Fault states are to be provided to Cardex systems in the form of digital inputs. The fault alarm shall include low fuel level.

The UON remotely monitors its electrical infrastructure though a site wide EMS (Energy Management System). This is a read only supervisory and data acquisition system that allows UON technical staff to monitor electrical infrastructure remotely at all times. All new generators shall be added to the EMS monitoring system. The configuration of the screen/interface for each generator will be completed by a UON preferred contractor, the collection of data for display on each interface can be completed by the generator installation contractor or a contractor of their choice. UON can suggest contractor to assist with the collection of data if required. The following information displayed on the UON EMS system.

- Mode
- Status
- E Stop
- Alarms Critical
- Alarms Non Critical
- Frequency
- Voltage L1-N
- Voltage L2-N
- Voltage L3-N
- Voltage L1-L2
- Voltage L2-L3
- Voltage L3-L1
- Current L1
- Current L2
- Current L3
- Kilowatts L1
- Kilowatts L2
- Kilowatts L3
- Gen Oil Pressure
- Engine Temp

- Gen RPM
- Battery Voltage
- Fuel level
- Energy

6. General Design

The Generator Set shall incorporate a Diesel drive engine and weather-protective and sound-attenuated enclosures with suitably rated lifting lugs. The sound attenuated enclosure shall reduce the noise level to no more than 75dB at 7 meters and enclose all moving parts. Both the cooling air and engine exhaust shall exit the unit vertically. The engine exhaust shall either be ducted through the skillion roof (maintaining roof seal) or a 90 degree bend installed to duct the exhaust away from the generator enclosure. Exhaust shall not be directed towards buildings or other populated area. All access doors shall be lockable using a UON SK key in a barrel internal to the door. An SK padlock is not acceptable. All door hinges shall be 316 stainless steel.

Any exposed length of exhaust greater than 100mm within 2 meters of the ground shall be thermally insulated to provide burn protection. The Generator set shall also include a fuel level indicator and low fuel level alarm and an Emergency Stop button on each of the long sides of the unit. The generator set shall be rated to run continuously at 50 Degrees Celsius.

Any fuel storage, internal or external to the generator, shall be within a double skinned storage cell or within a bund capable of holding 150% of the fuel cell capacity.

The Generator Set Engine shall be as Per UON preferred equipment list or approved in writing by the UON representative.

All ATS (Auto Changeover Switch) included in the generator backup system should not require a battery to operate and be wired to default to generator enable during a power failure. ATS shall be as per preferred equipment list. All neutrals shall be linked in the ATS, the neutral should not be broken while the ATS is operating.

All generator installation shall include a separate termination box, outside the generator enclosure, for the connection of a load bank. The installation should also include a MTS (Manual Transfer Switch) to allow an operator to switch generator power between the load bank and installation load. The installation load and the load bank shall not receive power simultaneously. The installation shall utilise a Socomec MTS.

All generator shall be shall utilise an electronic governor for speed control.

7. Installation

The Generator set should be installed in a location that: allows access for refuelling of the unit using a regular refuelling vehicle, limits the effect of generator noise, is not in a visually prominent position and not within 15 meters of a building air intake. The generator shall also be a minimum of Six meters from a door or window.

Any costs associated with the location of the generator such as service location or tree removal cost shall be included in any quote or installation proposal.

The generator Set should be install on a suitable rated concrete slab surrounded by a corrosion resistant, louvered fence that will both restrict the view of the generator and allow air flow.

The concrete slab shall be designed and installed in accordance with AS3600. The concrete shall: have a slump of 80, maximum aggregate size of 20mm, of blended type with a minimum grade of N32. The slab shall be of a thickness to support the load on the proposed generator set, but not less than 100mm. The clear concrete cover to reinforcement shall be a minimum of 40mm and concrete above ground shall be moist cured for a minimum of seven days. The surface of the concrete slab shall be a minimum of 50mm proud of the surrounding ground regardless of the fall of the natural ground or the required fall of the slab. The slab shall incorporate a fall to prevent the build-up of water on the slab. The slab shall protrude a minimum of 100mm beyond the perimeter of the fence. The concrete slab shall be finished with a non-slip surface.

The fence shall be a louvered type fence that will obscure the generator from sight but still allow adequate airflow around the unit. The fence should also allow for a minimum one meter access zone around all sides of the generator set, this zone may need to be increased to facilitate the opening of the generator access panels. The fence is to be constructed from corrosion resistant material and painted beige grey or blown. The fence shall include two access gates. Each gate shall be locked using the UON SK key with lighting control adjacent to the entry on the inside of the compound.

The generator shall be covered by a skillion type cover to protect the generator from the weather and falling vegetation. The cover shall be suitably rated for its size and can be integral to the existing slab and fence or completely separate with its own separate concrete footings. The cover shall be of all metal construction and no smaller in area than the concrete slab. The angle of the lean to shall be no less than 10 degrees.

The Generator Set shall be mounted on as per the manufacturer's instructions as a minimum. Any generator control or power cable shall be mechanically protected for a minimum of 1 meter above ground. All conduits run between the generator and the building shall be sealed to prevent water ingress. Any conduit running downhill towards the generator, with a fall greater than 500mm shall pass through a drained pit prior to turning up into the generator. No cabling or any other ducting shall be run above the generator slab. The generator shall include a stainless Steel label on the exterior of the generator containing the generator name (Supplied by UON), the format should be the letters GS followed by a number dictated by the number of generator sets on site. For example the seventh generator set onsite would be GS07, UNO will provide the generator number. The generator should also include a label adjacent to the main circuit breaker stating the name of the generator set and the name and location of the Distribution equipment supplied by that generator set.

8. Temporary Installations

Sizing of larger generator (50kVA and above) shall be completed in the same manner for Temporary/Rental generators as it is for permanently installed generators. For smaller generators BMS data and a data logger is not needed to establish required size, maximum demand can be estimated. Generator set should be rated at 20% above expected load. Sizing calculations and logic shall be presented to The UON representative prior to the purchase or rental of any temporary generator.

The sound attenuated enclosure shall reduce the noise level to no more than 75dB at 7 meters and enclose all moving parts. The Generator set shall also include a fuel level indicator Emergency Stop button on each of the long sides of the unit. The generator set shall be rated to run continuously at 50 Degrees Celsius. There shall be a minimum of 500 hour run time on the generator. The brand of generator shall be approved by the UON prior to rental.

If the required rental generator is the only source of power for a critical installation and it is not in itself a backup generator, the installation of a redundant generator should be considered. This may be in the form of a simple standby set that is hard wired and ready to be manually started and take the load if the primary unit has failed or it may be a spinning reserve and associated inter generator communications that will seamlessly take over in the event of a the primary unit failing. The UON should be consulted to establish the criticality of supply and any requirement for a redundant generator set.

9. Inspection, testing and commissioning

Phase rotation checks shall be completed to ensure that the generator phase rotation matches the mains power phase retaining.

If a temporary generator is to take the role of primary power supply for an installation while works is being completed on the permanent electrical infrastructure, the generator should be run under full load for at least 24 hours of normal operation before decommissioning any infrastructure. Generator redundancy with spinning reserve will be required in this situation.

Generator shall be fully tested and commission to manufacturers guidelines. As a minimum, the Generator Set shall be run under no load for 2 hours and under full load for a further 2 hours documenting all phase voltage, currents, frequency as well as Engine speed Lube pressure and cooling temperature for load and no load conditions. All test and commissioning documentation is to be presented UON rep for approval. The UON shall be given the opportunity to witness all testing.

Final factory inspection shall be carried out in the presence of the UON representative. Routine tests in accordance with AS 3439.1 Clause 8.3 shall be completed. The contractor shall provide 7 days prior notice for testing.

The contractor must submit the Certificate of Compliance – Electrical Work (CCEW), covering All installation work, to the Local Electricity Distributor. As well as supplying the CCEW, the Person who conducted all testing must submit test reports certifying the electrical installation.

The CCEW shall include:

- Confirmation of Circuits
- Megger tests
- Load Balance Data
- Phase Rotation
- Trip test of RCD's and provide test sheets with trip times.

The same phase rotation shall be used throughout installation, generally RWB clockwise.

10. Drawings and Data

The Contractor shall supply the following drawings for approval before manufacture, two weeks after award or at such time as stated in the Scope of Works:

- Front and side elevations of the assembly, with material list and component layout
- Single line diagram of the electrical power circuits through to the connection to the existing infrastructure including ATS and load test points.
- Control wiring diagram of all control circuits
- GA drawings of all installed electrical infrastructure.
- Full termination and wiring diagrams showing terminals
- Holding down details.
- Full equipment manual for generator and ATS
- GA arrangement for enclosure and generator placement.

A full set or operating and maintenance manuals are to be supplied with any purchased Generator Set, these documents shall be in PDF format. All generator manufacturer electrical, mechanical and other drawings should be supplier in PDF format. Drawings shall be provided for any change to UON Mechanical, Electrical or other infrastructure in both DWG and PDF formats.

A hard copy of the generator and associated electrical work drawings are to be installed in a document holder within the main access door of the generator enclosure. A copy of the operator and maintenance should also be provided in the same document holder. If a permanently installed Generator Set requires manual load shedding, instruction for the required switching shall be provided within the generator enclosure and within the switch room where the load shedding is required.

11. Defect Liability Period

The minimum Defect Liability Period for the project shall be twelve months.

12. Miscellaneous

Pay all fees to authorities in connection with applications, inspections and approvals.

Once the works is complete the area is to be cleaned so there is no sign of the work having taken place.